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# Eating styles in major depressive disorder: Results from a large-scale study

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ABSTRACT

Depressed persons have been found to present disturbances in eating styles, but it is unclear whether eating styles are different in subgroups of depressed patients. We studied the association between depressive disorder, severity, course and specific depressive symptom profiles and unhealthy eating styles. Cross-sectional and course data from 1060 remitted depressed patients, 309 currently depressed patients and 381 healthy controls from the Netherlands Study of Depression and Anxiety were used. Depressive disorders (DSM-IV based psychiatric interview) and self-reported depressive symptoms (Inventory of Depressive Symptomatology) were related to emotional, external and restrained eating (Dutch Eating Behavior Questionnaire) using analyses of covariance and linear regression. Remitted and current depressive disorders were significantly associated with higher emotional eating (Cohen's d = 0.40 and 0.60 respectively, p < 0.001) and higher external eating (Cohen's d = 0.20, p = 0.001 and Cohen's d = 0.32, p < 0.001 respectively). Little differences in eating styles between depression course groups were observed. Associations followed a dose-response association, with more emotional and external eating when depression was more severe (both p-values < 0.001). Longer symptom duration was also associated to more emotional and external eating (p < 0.001 and p = 0.001 respectively). When examining individual depressive symptoms, neuro-vegetative depressive symptoms contributed relatively more to emotional and external eating, while mood and anxious symptoms contributed relatively less to emotional and external eating. No depression associations were found with restrained eating. Intervention programs for depression should examine whether treating disordered eating specifically in those with neuro-vegetative, atypical depressive symptoms may help prevent or minimize adverse health consequences.

## 1. Introduction

In the modern Western society, depression is the most frequently diagnosed mental disorder (Kessler et al., 2003; Steel et al., 2014). While associations between depression and somatic and biological health have been recognized earlier (Penninx et al., 2013), only recently there has been attention for the link between depression and food-related behavior. This is a relevant topic to examine as well, as unhealthy diet and eating styles can contribute to depression's negative health consequences such as increased morbidity and mortality (Penninx et al., 2013). One of these consequences of depression is obesity (Luppino et al., 2010), for which diet is notoriously important.

Depressed persons have been found to present both disturbances in dietary patterns (Jacka et al., 2011; Quirk et al., 2013) as well as in eating styles (Brechan and Kvalem, 2015; Clum et al., 2014; Goldschmidt et al., 2014; Konttinen et al., 2010a, 2010b; Lazarevich et al., 2016; Ouwens et al., 2009; van Strien et al., 2016a; Werrij et al., 2006). Eating styles refer to a complex interplay amongst physiological, psychological, social and genetic factors that influence food preferences and quantity of food intake (Grimm and Steinle, 2011). Eating styles can influence depression indirectly by inducing unhealthy dietary patterns and obesity (Keskitalo et al., 2008; Konttinen et al., 2010a; Macht, 2008), which have shown to increase the risk of subsequent depression (Jacka et al., 2011; Luppino et al., 2010; Quirk et al., 2013). In addition, a few cross-sectional studies show high depressive symptoms to be associated to unhealthy eating styles (Brechan and Kvalem, 2015; Clum

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et al., 2014; Goldschmidt et al., 2014; Konttinen et al., 2010a, 2010b; Lazarevich et al., 2016; Ouwens et al., 2009; van Strien et al., 2016a; Werrij et al., 2006). There seems to be a vicious circle, possibly going both ways, in which a systematic understanding of the important direct association from clinical depression to eating styles is lacking.

Three different eating styles, based on three psychological theories, have been identified over the past decades. The psychosomatic theory on emotional eating assumes that some people are unable to distinguish hunger from other bodily arousal (e.g. emotions) (Bruch, 1961), while the externality theory on external eating suggests that exposure to attractive food and food-related external stimuli triggers eating (Schachter, 1964). The restrained theory on restrained eating assumes individuals with overweight and obesity to be chronic dieters, who constantly try to cognitively regulate their eating. However at some point this control breaks down due to "emotional turmoil", and they start to overeat again (Herman and Mack, 1975).

Previous studies that showed cross-sectional associations between depressive symptoms and eating styles (Brechan and Kvalem, 2015; Clum et al., 2014; Goldschmidt et al., 2014; Konttinen et al., 2010a, 2010b; Lazarevich et al., 2016; Ouwens et al., 2009; van Strien et al., 2016a; Werrij et al., 2006), all operationalized depression by using one overall severity of symptoms score in general populations, and thereby have limited generalizability to clinical samples. Two studies only included females (Clum et al., 2014; Ouwens et al., 2009), and one only investigated adolescents (Lazarevich et al., 2016). Also, in three studies, the participants' mean body mass index was above 30 kg/m$^2$ (indicating obesity (Clum et al., 2014; Goldschmidt et al., 2014; Ouwens et al., 2009);). None of these studies actually investigated patients with major depressive disorder as established by formal psychiatric diagnostic criteria. Furthermore, symptom heterogeneity among individuals diagnosed with major depressive disorder is well-established, and some clear subtypes of depression (e.g. atypical versus melancholic symptom profiles) have been successfully verified (Fried and Nesse, 2015; Lamers et al., 2012). The atypical symptom profile is characterized by increased appetite (Lamers et al., 2010; Milaneschi et al., 2015), a heightened risk of obesity (Levitan et al., 2012) and subsequent weight gain (Lasserre et al., 2014), and consequently likely represents a group of patients who are at risk for unfavorable eating styles. Moreover, studies show depression to be related to disturbances in neurobiological appetite-related processes (Milaneschi et al., 2014; Penninx et al., 2013; Zupancic and Mahajan, 2011). Associations are found with metabolic disturbances (Penninx et al., 2013) like the functioning of the hormone leptin, which is involved in appetite regulation. Increasing evidence indicates that depression is associated with reduced leptin signaling to the central nervous system (Milaneschi et al., 2014; Zupancic and Mahajan, 2011), specifically within the atypical depression subtype. This work indicates that depression might be associated with eating styles by affecting appetite-regulating processes. However, due to the lack of studies relating specific depressive symptoms to eating styles, it remains unclear whether depression is consistently associated with emotional, external and restrained eating, and whether different associations with eating styles exist between different subgroups of depression.

Since depressive symptoms and unhealthy eating styles are shown to be associated, and eating styles can also induce unfavorable health outcomes like unhealthy dietary patterns and obesity, it is crucial to have a thorough understanding of the associations between depression and unhealthy eating styles. Therefore, this study investigates the cross-sectional and longitudinal associations between depression disorders in their full clinical heterogeneity and three disordered eating styles; emotional, external and restrained eating. In a large cohort, we will examine if and how participants with a diagnosis of current or remitted depression disorders differ in eating styles as compared to healthy controls. In addition we will examine which specific depression characteristics (severity, symptom profiles, individual symptoms), and changes in depressive disorder characteristics (course, duration) are associated with emotional, external and restrained eating.

## 2. Materials and methods

### 2.1. Study sample

Data from the Netherlands Study of Depression and Anxiety (NESDA), an ongoing cohort study of people with depressive and anxiety disorders and healthy controls were used. In order to represent diverse settings and developmental stages of psychopathology, 2981 adults (18-65 year) from the community (19%), general practice (54%) and specialized mental health care (27%) were included at baseline. Exclusion criteria were a primary clinically overt diagnosis of other psychiatric disorders such as psychotic disorder, obsessive-compulsive disorder, bipolar disorder, or severe substance abuse disorder, and insufficient command of the Dutch language. The research protocol was approved by the Ethical Committees of the contributing universities and all participants provided written informed consent. A detailed description of the NESDA study design can be found elsewhere (Penninx et al., 2008). Between September 2004 and February 2007, all participants underwent a baseline assessment containing an extended face-to-face interview conducted by a trained research assistant, which included a standardized diagnostic psychiatric interview (Composite International Diagnostic Interview (CIDI) version 2.1 (Wittchen, 1994)) and self-report questionnaires. Every 2 years after the baseline assessment, face-to-face follow-up assessments were conducted. Follow-up assessments had a response of 87.1% (N = 2596) at the 2-year follow-up, 80.6% (N = 2402) at the 4-year follow-up, 75.7% (N = 2256) at the 6-year follow-up, and 69.4% (N = 2069) at the 9-year follow-up. This paper is based on data of the 9-year follow-up wave in which eating styles were measured. Data of earlier waves was used to create psychiatric status groups.

### 2.2. Depression measurements

During each assessment, presence of a DSM-IV depressive (MDD, dysthymia) or anxiety disorder was established using the CIDI (Wittchen, 1994). At the 9-year follow up, all participants were classified as 1) a control subject, 2) having a remitted depressive disorder, or 3) having a current diagnosis based on information from baseline to 9-year follow up. Control subjects were defined as having no lifetime history of depressive or anxiety disorders at all. Persons in the remitted group had a lifetime history of depression disorder but no diagnosis in the past 6 months as diagnosed with the CIDI, and current patients had CIDI-diagnosed depressive disorder (major depressive disorder, dysthymia) in the past 6 months. Nine year follow-up data was available for 2069 participants. After excluding participants with pure anxiety disorders (n = 195), on whom data on psychiatric disorders was inconclusive due to too many missing follow-up data (n = 13), and persons with missing data on the psychological eating styles (n = 111), the final study sample consisted of 1750 participants (381 controls, 1060 participants with a remitted depressive disorder, and 309 with a current depressive disorder).

At 9 year follow-up, severity of depressive symptoms in the past week was assessed with the 30-item Inventory of Depressive Symptomatology - Self Report (IDS-SR, range 0–84 (Rush et al., 1996);). Items were scored from 0 ('no problems') to 3 ('severe problems'). In line with previous studies, symptoms were recoded into dichotomous variables, with a score of 0 or 1 indicating the symptom was not present, and a score of 2 or 3 indicating presence of the symptom (Khan et al., 2016; Schaakxs et al., 2016). The separate items weight loss and weight gain were recoded into a single three-category variable: no change (score of 0 or 1 on both variables), decreased weight (score of 2 or 3 on weight loss), or increased weight (score of 2 or 3 on weight gain). Increased appetite and decreased appetite were recoded similarly. The item asking about diurnal variation was recoded to

distinguish those with worse mood in the morning from those with no diurnal variation or no worse mood in the morning.

In order to further improve clinical interpretability, individual symptoms were categorized into symptom clusters, as was done earlier in similar ways (Schaakxs et al., 2016; Wardenaar et al., 2010; Wiltink et al., 2013). Three symptom clusters were made: mood symptoms, somatic/vegetative symptoms and cognitive symptoms. For each cluster, a sum score was created. In the somatic/vegetative cluster, the items 'weight loss', 'weight gain', 'decrease in appetite', and 'increase in appetite' were added separately, however participants could only obtain a score on either decreased or increased appetite/weight, not on both. As a result, the mood sum score potentially ranged from 0 to 30, the cognitive sum score ranged from 0 to 12, and the somatic/vegetative sum score ranged from 0 to 42. Furthermore, presence of individual depressive symptoms was assessed. Individual dichotomous depressive symptoms were used to get an impression of the role of the melancholic and atypical depression features.

To investigate the associations of the prior course of depressive disorders with eating styles, the following six course groups were created based on 12-month diagnosis status at baseline and at the 2- 4-, 6- and 9-year follow-ups (persons were allowed to have one missing observation): 1) control group, 2) new episode onset, 3) persistently remitted course, 4) relapsing course, 5) remission, and 6) chronic course (for details, see Supplementary Table 1 and (Verhoeven et al., 2016)). Furthermore, duration of depressive symptoms was determined as percentage of time with depressive symptoms during each of the 2-year intervals between the follow-up assessments, as assessed by the calendar method of the Life Chart interview (Lyketsos et al., 1994). Time with symptoms between assessments was averaged to calculate the average percentage of time with symptoms over the 9-year period.

### 2.3. Eating styles

At the 9-year follow up, the short version Dutch Eating Behavior Questionnaire (DEBQ) (van Strien, 2015; van Strien et al., 1986) was used to assess emotional eating (6 items, e.g. "Do you have a desire to eat when you are irritated?"), external eating (7 items, e.g. "If food smells and looks food, do you eat more than usual?") and restrained eating (7 items, e.g. "Do you try to eat less at mealtimes than you would like to eat?"). Response categories range from 1 'never' to 5 'very often'. The full version DEBQ scales have high internal consistency, high validity for food consumption, and high convergent and discriminative validity (COTAN, n.d.; van Strien, 2015). The current study showed, using exploratory factor analysis, that all items in this analysis had primary loadings over 0.57, with the mean factor loadings being 0.84 for the emotional eating scale, 0.79 for the external eating scale and 0.67 for the restrained eating scale. The non-target loadings (loadings in factors that the item was not intended to measure) had a mean value of 0.15, 0.09 and 0.14 for the emotional, external and restrained eating scales respectively, with an overall range from 0.01 to 0.30. Internal consistency for the three subscales was adequate (emotional eating $\alpha = 0.95$, external eating $\alpha = 0.82$, restrained eating $\alpha = 0.91$). The inter-correlation between emotional and external eating was found to be 0.52, 0.29 between emotional and restrained eating, and 0.17 between external and restrained eating.

### 2.4. Sociodemographic and lifestyle and health variables

Age, sex, years of education and ethnicity were assessed during the interview. Lifestyle and health variables were measured at 9-year follow-up and contained current and former smoking, current alcohol use and current body mass index (BMI). Current smoking was operationalized by number of cigarettes per week using the Fagerstrom Test for Nicotine Dependence (Heatherton et al., 1991). Typical alcohol use during the past year was expressed in number of drinks per week using the AUDIT questionnaire (Saunders et al., 1993). Body weight was measured at each visit by a trained research assistant. BMI was calculated as weight kilograms divided by height squared in meters ($kg/m^2$). Antidepressant use was assessed at 9-year follow up by asking participants to bring their medication containers. These were classified according to the Anatomical Therapeutic Chemical (ATC) classification (World Health Organisation (WHO), 2014). Antidepressants were grouped according to type into the following three groups: tricyclic antidepressants (TCA's) (ATC code: N06AA), selective serotonin reuptake inhibitors (SSRIs) (ATC code: N06AB), and other antidepressants. For total antidepressant use, a dichotomous yes/no variable was computed.

### 2.5. Statistical analyses

Analyses were conducted using SPSS version 22.0 (IBM Corp., Armonk, NY, USA). In the analyses with depression diagnosis or severity of depression as predictors, a p-value of 0.05 was considered statistically significant.

First, 9-year follow-up sample characteristics were described as means and standard deviations, or percentages. All subsequent analyses were adjusted for age, gender, years of education, and ethnicity. Analyses of covariance (ANCOVA) were used to determine differences in the three unhealthy eating styles (outcome variables) in the remitted and current depression groups as compared to healthy controls, using post-hoc Bonferroni corrections to analyze the differences between the three groups. For significant results, Cohen's d ($Mean_1 - Mean_2 / SD_{pooled}$) was determined as an estimation of effect size. Linear regression analyses were used with overall severity of depressive symptoms, and specific depressive symptom clusters as predictor variables and eating styles as outcome. Severity and symptom clusters were standardized before entered into the model, to make their effects comparable. The predictor variables were entered into the model separately.

Hereafter, some additional analyses were performed. We checked whether dichotomous antidepressant use was of influence in the association between depression diagnosis or severity and eating styles, by adding this variable to the ANCOVA and linear regression analyses as a covariate. It was also examined whether there was an interaction effect of gender by adding interaction terms of gender*psychopathology, since stratification for gender was done in some earlier studies (Konttinen et al., 2010a, 2010b; Lazarevich et al., 2016; van Strien et al., 2016a). In another analysis emotional and external eating styles were controlled for each other, since emotional and external eating were positively correlated ($r = 0.52$). Finally, to study whether the associations between depression and eating styles were independent of a range of lifestyle and health variables, multiple linear regression analyses were performed. Analyses related depression severity, general (sociodemographic) and lifestyle (BMI, smoking, alcohol use) characteristics to eating styles. Each variable was entered into the regression analyses separately first, variables found to be significantly associated with the eating styles in the previous analyses were combined into a final regression model. This analyses will be repeated for depressive symptom clusters.

To investigate to what extent specific depressive symptoms were associated with eating styles, regression analyses were performed for all depressive symptoms separately. We corrected for multiple testing with use of the modified FDR (B-Y) method (Narum, 2006). These analyses were corrected for overall depression severity, to study the pure effects of the single depressive symptoms on top of the effect of depression severity, rather than studying individual symptoms without correction that would reflect a combination of that particular symptom and overall depression severity.

Associations between 9-year changes in depression status and eating styles were investigated using ANCOVA analyses, with post-hoc Bonferroni corrections to analyze the differences between course groups. Linear regression analyses were used for studying associations

**Table 1**
Sample characteristics (N = 1750).

| | Controls N = 381 | Remitted depressive disorders N = 1060 | Current depressive disorders N = 309 | Total group N = 1750 |
|---|---|---|---|---|
| Demographics | | | | |
| Age (mean, sd) | 50.6 (14.6) | 51.2 (12.9) | 51.3 (11.6) | 51.2 (13.0) |
| Gender (%, female) | 57.4 | 68.2 | 68.3 | 66.0 |
| Education (years, mean, sd) | 13.8 (3.3) | 12.9 (3.1) | 12.8 (3.4) | 13.0 (3.3) |
| Ethnicity (%, North European) | 97.0 | 95.9 | 92.8 | 95.6 |
| Lifestyle | | | | |
| BMI ($kg/m^2$,mean, sd) | 25.8 (4.7) | 26.3 (4.8) | 27.1 (5.4) | 26.5 (4.9) |
| Smoking (cigarettes/week) (mean, sd) | 10.3 (32.0) | 20.6 (46.6) | 24.1 (51.5) | 19.4 (45.8) |
| Alcohol use (drinks/week) (median, IQR) | 6.3 (8.3) | 6.0 (8.7) | 5.1 (8.7) | 3.7 (8.0) |
| Psychiatric characteristics | | | | |
| Severity of depressive symptoms (mean, sd) | 6.1 (5.3) | 14.4 (9.3) | 28.8 (12.3) | 15.3 (12.0) |
| Mood symptom cluster score (mean, sd) | 0.1 (0.4) | 0.7 (1.3) | 3.0 (2.6) | 1.0 (1.8) |
| Somatic symptoms cluster score (mean, sd) | 1.0 (1.1) | 2.0 (1.8) | 4.0 (2.6) | 2.2 (2.0) |
| Cognitive symptoms cluster score (mean, sd) | 0.1 (0.3) | 0.3 (0.6) | 1.1 (1.1) | 0.4 (0.8) |
| Course duration[a] | 1.7 | 21.9 | 51.2 | 22.7 |
| Psychological eating styles scores | | | | |
| Emotional eating (mean, sd) | 2.0 (0.8) | 2.4 (1.0) | 2.7 (1.0) | 2.4 (1.0) |
| External eating (mean, sd) | 2.6 (0.6) | 2.7 (0.6) | 2.8 (0.6) | 2.7 (0.6) |
| Restrained eating (mean, sd) | 2.6 (0.9) | 2.7 (0.9) | 2.7 (0.9) | 2.7 (0.9) |

IQR = inter quartile range.
[a] Average % time with depressive symptoms during prior nine years.

between symptom duration over the 9-year period and eating styles.

## 3. Results

### 3.1. Descriptives

Participants' mean age was 51.2 (sd = 13.0), and almost two-third of the total sample was female (Table 1). The three groups had a similar mean BMI, current patients smoked the most cigarettes, and drank the least alcohol per week. Those in the current patient group showed, as expected, the highest scores on overall depression severity and depressive symptom clusters.

### 3.2. Depression diagnosis, depression severity and eating styles

Patients with a remitted depressive disorder as well as with those with a current depressive disorder showed higher levels of emotional eating and external eating as compared to the healthy controls, adjusted for sociodemographic variables (Fig. 1). Those with a current depressive disorder also showed significantly higher levels of emotional eating as compared to the remitted group. The found effect sizes ranged from small to medium (Cohen's d = 0.22 - 0.62, Fig. 1). No significant differences were found for restrained eating. In line with a dose-response association, participants with higher depressive symptoms, assessed with the IDS questionnaire, also showed higher levels of emotional and external eating, but no association with restrained eating was found (Fig. 2). Results showed that the mood, somatic and cognitive symptom clusters also had a positive association with emotional and external eating: the more mood, somatic and cognitive symptoms a patient had, the more emotional and external eating this patient showed (Fig. 2). No significant associations were found for restrained eating.

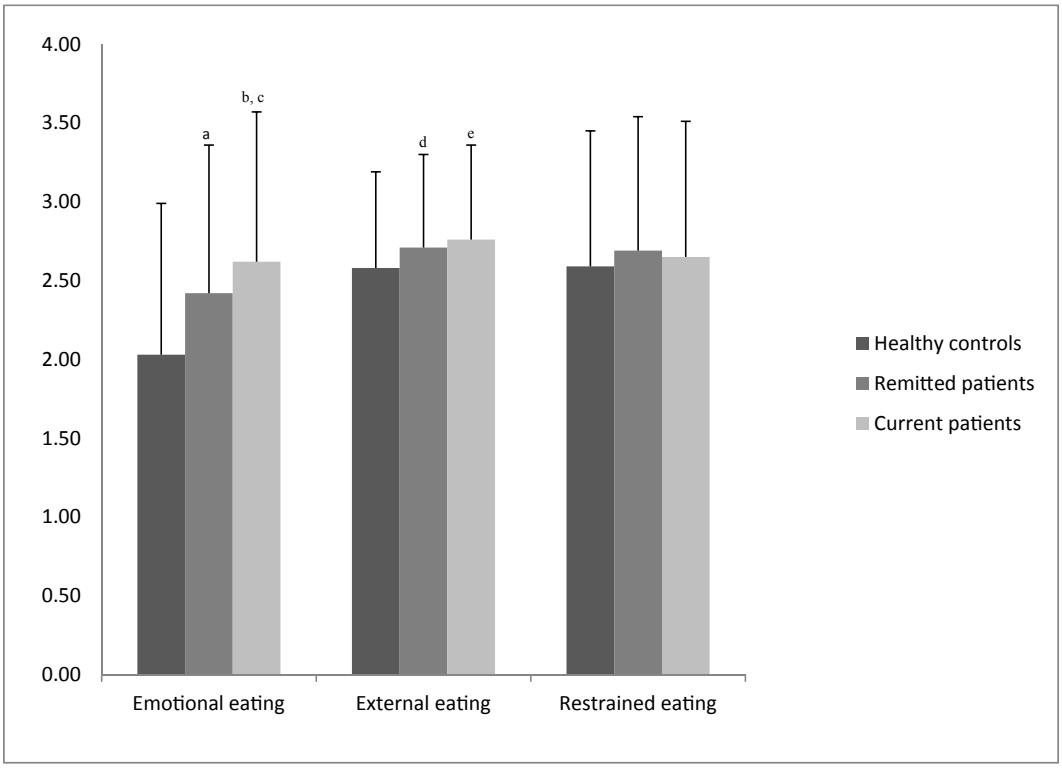
Additional adjustment for antidepressant use on top of correction for the sociodemographic variables did not modify the results (data not shown). We found no significant interaction effects for depression status by gender (*p*-values ranged from 0.17 to 0.84), and therefore we did not perform the analyses stratified by gender. After adding external eating as covariate in the analysis on emotional eating, and vice versa, results showed that the association between depression diagnosis and severity and emotional eating remained significant ($F = 27.48$, $p < 0.001$ and $\beta = 0.18$, $p < 0.001$ respectively), the association with external eating turned non-significant ($F = 37.0$, $p = 0.69$ and $\beta = 0.01$, $p = 0.64$ respectively). When investigating the role of lifestyle and health variables, analyses of the univariable models showed that general characteristics age, gender and years of education, and lifestyle characteristics BMI, smoking and alcohol use were significantly associated with all three eating styles (Table 2). Combining those variables with depression severity in a multivariable model showed depression severity to still be significantly associated to emotional and external eating. Similar results were found in additional analyses with the depressive symptom clusters instead of total depression severity (data not shown).

### 3.3. Individual depressive symptoms and eating styles

After correction for multiple testing, on top of the effect of depression severity, associations between individual depressive symptoms varied from positive to negative. Seven out of 30 depressive symptoms were found to have a relative smaller contribution to emotional eating, while two contributed relatively more to emotional eating (Fig. 3; Supplementary Table 2). The neuro-vegetative symptoms 'increase in appetite' and 'weight gain' showed to be more important contributors to emotional eating, whereas 'decrease in appetite' was shown to contribute less to emotional eating. 'Increase in appetite' and 'weight gain' are symptoms strongly associated to depression with atypical features. Mood and anxiety symptoms that contributed relatively less to emotional eating levels were: 'diminished reactivity of mood', 'diminished capacity for pleasure or enjoyment', 'feeling sad', 'panic/phobic symptoms', 'feeling anxious or tense' and 'diminished quality of mood'. The remaining symptoms were not significantly associated with emotional eating.

For external eating, five symptoms contributed relatively less, and two contributed more to external eating, on top of the effect of depression severity (Fig. 3; Supplementary Table 2). Again, the neuro-vegetative symptoms 'increase in appetite' and 'weight gain' contributed more to external eating. 'Diminished reactivity of mood', 'diminished capacity for pleasure or enjoyment', 'feeling sad', 'constipation/diarrhea' and 'low energy level' showed to have a smaller contribution to external eating levels.

Finally, two symptoms showed a larger contribution to restrained eating, 'weight gain' as well as 'weight loss' (Fig. 3; Supplementary Table 2). Four symptoms showed to contribute relatively less to restrained eating. These were 'decrease in appetite', 'diminished reactivity of mood', 'low energy level' and 'leaden paralysis'.




Adjusted means and standard deviations derived from ANCOVA are presented
All analyses adjusted for age, gender, years of education and ethnicity
[a] Significantly different from control group (post hoc, Bonferroni correction p < 0.01), Cohen's d = 0.40
[b] Significantly different from control group (post hoc, Bonferroni correction p < 0.01), Cohen's d = 0.62
[c] Significantly different from remitted group (post hoc, Bonferroni correction p = 0.01), Cohen's d = 0.22
[d] Significantly different from control group (post hoc, Bonferroni correction p = 0.01), Cohen's d = 0.22
[e] Significantly different from control group (post hoc, Bonferroni correction p < 0.01), Cohen's d = 0.30

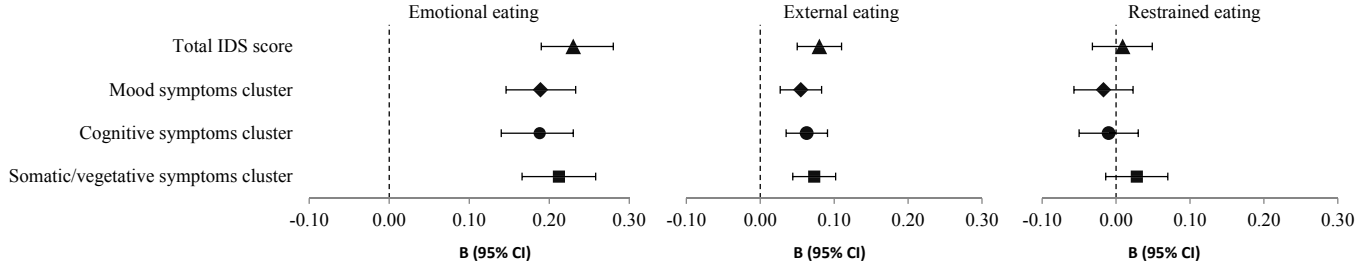
**Fig. 1.** Eating styles (adjusted mean and SD) by depressive disorder groups (N = 1750).

### 3.4. Course of depression and eating styles

ANCOVA analyses tested whether six groups based on diagnosis status at baseline and at 2-, 4-, 6- and 9-year follow-up predicted eating styles at 9-year follow-up. Results showed an overall association of course groups with emotional ($F = 15.31$, $p < 0.001$) and external eating ($F = 4.78$, $p < 0.001$), but not with restrained eating ($F = 1.09$, $p = 0.36$). The relapse ($p < 0.001$ and $p = 0.02$), remitted ($p < 0.001$ and $p = 0.04$) and chronic (both $p$-values < 0.001) groups had significantly higher levels of emotional and external eating respectively as compared to the healthy controls (Supplementary Table 1). The chronic group also showed higher levels of emotional eating as compared to the persistently remitted group ($p < 0.001$). No differences were found between other course groups. With respect to the duration of depressive symptoms, longer mean duration was significantly associated with emotional eating (B = 0.67, 95% confidence interval (CI) = 0.50; 0.85) and external eating (B = 0.18, 95% CI = 0.07; 0.29), but not with restrained eating (B = -0.05, 95% CI = -0.21; 0.11).

## 4. Discussion

Using a large cohort of depressed patients and healthy controls, the current study is the first to examine the associations of depressive disorder and individual depressive symptoms, with three disordered eating styles; emotional, external and restrained eating. Results showed that




All analyses are adjusted for age, gender, years of education and ethnicity
The predictor variables are entered into the model separately.
■ somatic symptoms, ◆ mood symptoms, ● cognitive symptoms

**Fig. 2.** Multiple linear regression analyses with standardized depression severity and symptom clusters as predictor and eating style as outcome variable (N = 1750).

**Table 2**
Multiple linear regression analyses on the associations between depression severity, general characteristics and eating style (N = 1750).

| | Emotional eating | | | | External eating | | | | Restrained eating | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Univariable model | | Multivariable model | | Univariable model | | Multivariable model | | Univariable model | | Multivariable model | |
| | β | *p*-value | β | *p*-value | β | *p*-value | β | *p*-value | β | *p*-value | β | *p*-value |
| Depression severity | **0.22** | **< 0.001** | **0.21** | **< 0.001** | **0.10** | **< 0.001** | **0.12** | **< 0.001** | 0.01 | 0.73 | – | – |
| General characteristics (N = 1750) | | | | | | | | | | | | |
| Age | **−0.12** | **< 0.001** | **−0.14** | **< 0.001** | **−0.20** | **< 0.001** | **−0.21** | **< 0.001** | **0.05** | **0.02** | **0.06** | **0.01** |
| Gender (female) | **0.22** | **< 0.001** | **0.22** | **< 0.001** | **0.08** | **0.001** | **0.07** | **0.01** | **0.17** | **< 0.01** | **0.16** | **< 0.001** |
| Years of education | **0.05** | **0.04** | **0.10** | **< 0.001** | **0.06** | **0.01** | **0.09** | **0.001** | **0.07** | **0.01** | **0.09** | **< 0.001** |
| Ethnicity (North-European) | −0.01 | 0.69 | – | – | −0.04 | 0.11 | – | – | 0.01 | 0.63 | – | – |
| Health and lifestyle | | | | | | | | | | | | |
| BMI (kg/m$^2$) | **0.26** | **< 0.001** | **0.30** | **< 0.001** | **0.10** | **< 0.01** | **0.15** | **< 0.001** | **0.20** | **0.001** | **0.22** | **< 0.001** |
| Smoking | **−0.08** | **0.001** | **−0.08** | **0.001** | −0.01 | 0.85 | – | – | **−0.20** | **< 0.001** | **−0.18** | **< 0.001** |
| Alcohol use | **−0.14** | **< 0.001** | **−0.05** | **0.04** | **−0.06** | **0.01** | −0.004 | 0.88 | **−0.09** | **< 0.001** | −0.03 | 0.23 |

Characteristics are entered into the regression analyses separately first. Thereafter, variables found to be successfully contributing to the eating styles at the previous analyses are entered in the multivariate model simultaneously. *p*-values < 0.05 are printed in bold.

patients with a current and remitted depressive disorder reported significantly more emotional and external eating, but not restrained eating. Differences in eating styles were found between healthy controls and different depressive course groups, however little differences between the depressive course groups were observed. The association with emotional eating was stronger than the association with external eating. When adjusting for external eating, the association between depression and emotional eating remained significant, however the association with external eating turned non-significant when emotional eating was entered into the analyses. A dose-response relationship was found for the association between depression severity and emotional and external eating. Results revealed the same patterns for the mood, somatic and cognitive symptom clusters and emotional and external eating. Longer symptom duration was also associated with more emotional and external eating. Further analysis showed that the association between overall depression severity and emotional and external eating remained significant after adding a range of general, health and unhealthy lifestyle variables. This study demonstrated overlapping and differential associations between individual depressive symptoms and the three eating styles. Specific neuro-vegetative depressive symptoms like 'increased appetite' and 'weight gain', associated to depression with atypical features, were shown to contribute relatively more to emotional eating. Specific mood symptoms, associated to depression with melancholic features, and anxious symptoms showed to have a smaller contribution to emotional eating. The specific neuro-vegetative and mood symptoms showed comparable associations with the external eating. The few associations between depressive symptoms and restrained eating showed a slightly different pattern, both 'weight gain' and 'weight loss' contributed relatively more to restrained eating. This possibly reflects the nature of this eating style, with both periods of dietary restraint as well as periods with less control over eating. The results of our study indicate that depression should not only be used as one homogeneous variable when investigating eating behavior, since different individual symptoms showed different associations with the eating styles.

Our results are in line with previous studies that showed

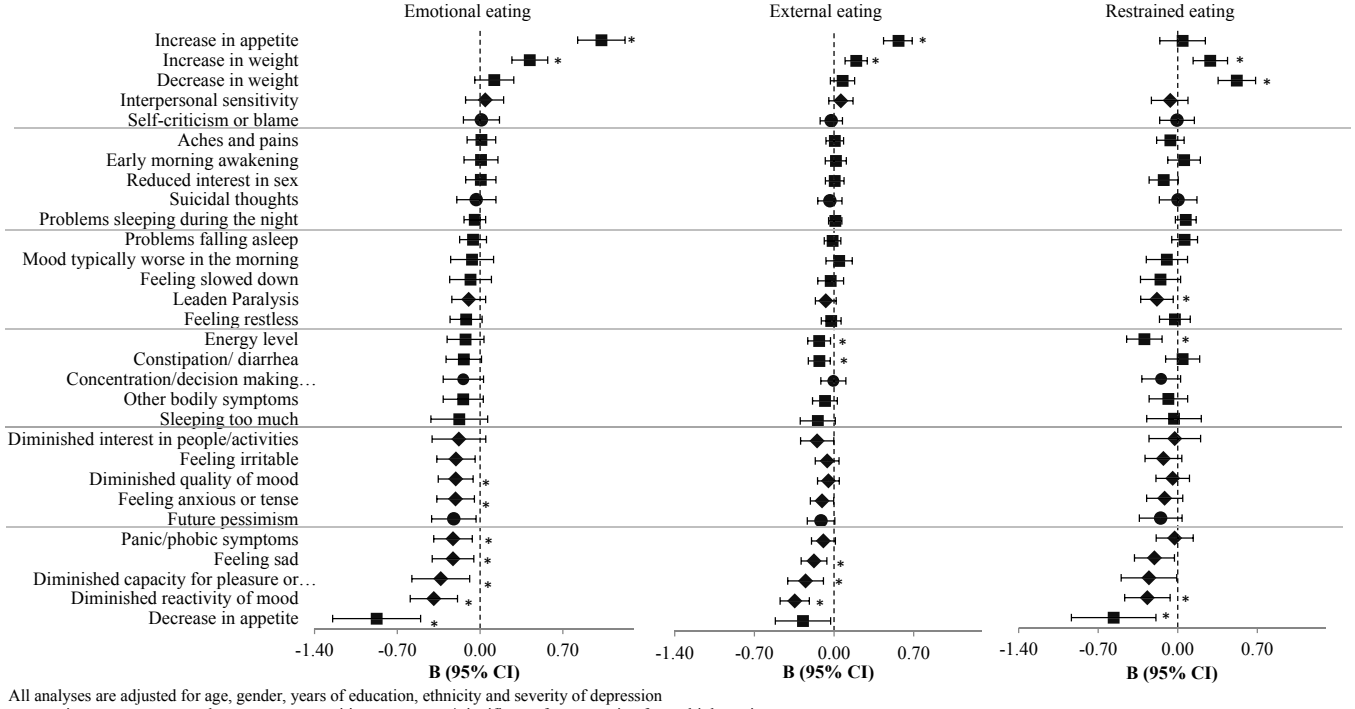



**Fig. 3.** Multiple linear regression analyses depressive symptoms as predictor and eating style as outcome variable, with correction for depression severity (N = 1750).

associations between depression severity and emotional eating (Clum et al., 2014; Goldschmidt et al., 2014; Konttinen et al., 2010a, 2010b; Lazarevich et al., 2016; van Strien et al., 2016a; Werrij et al., 2006). Another study also found that the association between depression and external eating turned non-significant when correcting for emotional eating (Ouwens et al., 2009). In addition, we are the first to report that depressive diagnosis is also associated with these two eating styles, and showed that more depression severity was related to these two eating styles.) These associations remained significant after correction for the sociodemographic variables age, gender, years of education and ethnicity, and the health variables BMI, smoking, and alcohol use. Our results strengthen the knowledge on the vicious circle between eating styles, unhealthy lifestyle aspects, and depression. Both remitted and current patients showed higher levels of emotional and external eating as compared to the healthy controls. Also, little differences were found between the different depressive course groups. This could be indicative of eating styles being more trait rather than state variables, and not altering rapidly when mood changes. However, the duration of depressive symptoms does seem to affect the levels of emotional and external eating, with higher duration being associated to higher levels. These distinct findings between different measures of depression duration might be due to different ways of measuring duration. For the course groups, only information of 1 year prior to assessment was taken into account, while the Lifechart method includes the total period between assessments. Also, the course groups have a smaller N, which can cause less power in the analyses. No firm conclusions about the effects of depression duration on eating styles can be drawn. In line with a study of Konttinen et al (2010) (Konttinen et al., 2010a), but as opposed to most earlier findings (Brechan and Kvalem, 2015; van Strien et al., 2016a; Werrij et al., 2006), we did not find significant associations between depression and restrained eating. The study of Clum et al. did initially also find a significant correlation between depressive symptoms and restrained eating (Clum et al., 2014). However, when combining both variables with a range of other related variables, including emotional eating and BMI, in a more extensive path analysis, the association disappeared. In addition, in the three studies that did find associations between depressive symptoms and restrained eating, the participants displayed only minimal or borderline to mild depressive symptoms (Brechan and Kvalem, 2015; van Strien et al., 2016a; Werrij et al., 2006). Thus, it could be that the association is no longer present as the depressive symptoms get worse.

Earlier literature has suggested several mechanisms that could explain why depression and emotional and external eating are associated. A study in adolescents suggested a possible role for decreased serotonin (5-HTTLPR polymorphism in serotonin transporter gene) (van Strien et al., 2010). This study found that adolescents with depressive symptoms showed more increase in emotional eating if they carried the 5-HTTLPR genotype that results in lower serotonin activity (s-allele). However, the authors did not find similar results in a more recent study in adults (van Strien et al., 2016a). Also, associations have been found between dopamine transporter gene (SLC6A3), specifically, those with the 10/10 allele, and increased intake of calorie dense and sweet foods in women with higher depressive symptoms (Agurs-Collins and Fuemmeler, 2011). Psychological factors have also been proposed as mechanisms that underlie the associations between depression and eating styles. Ouwens et al. (2009) showed indirect pathways between depression and emotional eating through the concepts of difficulties identifying feelings (alexithymia) and impulsivity (Ouwens et al., 2009). In the same study, no such pathways were found for external eating. Another study suggest that persons high on emotional eating use eating to alleviate negative emotional states (Spoor et al., 2007). In contrast, the escape theory suggests that some people (e.g. emotional eaters) narrow their level of attention to the current and immediate stimulus environment (accessible food cues such as snacks), in order to distract attention from negative affect (e.g. depression), hence leading to external eating (Heatherton and Baumeister, 1991). The current study provides new insights on the differential associations between specific depressive symptoms and disordered eating styles. As expected, our results show positive associations between the atypical, neuro-vegetative symptoms and 'reactivity of mood', and emotional and external eating. This was also suggested by an earlier study (van Strien et al., 2016b), although the authors classified a person having atypical characteristics by a single question on appetite, while gaining weight is another important discriminator of atypical depression features (Milaneschi et al., 2015). The observed association of the atypical depression features 'increase in appetite' and 'weight gain' with eating styles suggests that eating styles could be a target in the treatment of those with atypical features. By teaching those depressed patients better emotion regulation skills, unhealthy eating styles can possibly be diminished, which could subsequently reduce adverse health consequences like further weight gain, unhealthy dietary patterns and weight-related diseases. Our finding that only emotional eating remains significant when adding external eating to the analysis, but not the other way around, suggests that treatment should focus mostly on affect regulation problems, like emotional eating. While some studies do find treatment directed to affect regulation to be successful in lowering emotional eating in people with overweight or obesity (Forman et al., 2009; Roosen et al., 2012), others, of which one was directed to lowering energy intake, do not find treatment to be effective (Goldbacher et al., 2016; van Strien and van de Laar, 2008). However, due to small sample sizes, continued efforts need to focus on developing treatment strategies that have a sizable impact on emotional eating and subsequent dietary intake. Nevertheless, therapists should consider whether they are dealing with a patient with atypical, or melancholic features.

The current study has several strengths. No previous study has measured the associations of diagnosed depression, depression mood clusters and specific symptoms of depression with eating styles. Also, the current study included a large, generalizable group of participants, recruited from community, general practice and specialized mental health care. However, this study also suffers from some limitations. The most important one is the use of mostly cross-sectional data. Although it is likely that higher levels of depression lead to higher levels of eating styles, it is also possible that eating styles, in particular emotional eating, lead to negative emotions. Emotion-regulation theories discuss the possibility that there are associations between a certain affect-regulation strategy (in this case, emotional eating) followed by a change in emotional state (Gross and Thompson, 2007). However, recently a meta-analysis showed that emotional eating does not lead to a better affect (Haedt-Matt et al., 2014). Another limitation is the use of self-report data, which poses the risk of social desirable answering, it is known that people have a tendency to underreport eating styles (van Strien, 1995). Finally, no information on binge eating disorder (BED) was available, while studies suggest strong associations between BED and both depression and eating styles (Eldregde and Agras, 1996; Grilo et al., 2009; Pinaquy et al., 2003).

In summary, our findings are the first to indicate that patients with a remitted or current depressive disorder have more emotional and external eating, but similar restrained eating compared to healthy controls. We also confirm the associations between depressive symptom severity and both emotional and external eating. These associations remain significant after adding unhealthy lifestyle factors to the model. The neuro-vegetative depressive symptoms such as appetite increase and weight gain, associated with the atypical subtype, showed to contribute relatively more to emotional and external eating. Mood symptoms associated to the melancholic subtype showed to have a relatively smaller contribution. Therefore, it seems that the associations between depression and eating styles are not similar across the full spectrum of depressive disorders. Prevention and treatment programs for depression should address disordered eating specifically in those with neuro-vegetative, atypical depressive symptoms. This could prevent or minimalize the subsequent negative health consequences like unhealthy

dietary patterns and weight gain, thereby aiding the break-through of this unhealthy vicious circle.

## Conflicts of interest

Tatjana van Strien has a copyright and royalty interest in the Dutch Eating Behavior Questionnaire (DEBQ) and manual. The other authors report no conflict of interest.

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## Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.jpsychires.2017.11.003.

## References

Agurs-Collins, T., Fuemmeler, B.F., 2011. Dopamine polymorphisms and depressive symptoms predict foods intake: results from a nationally representative sample. Appetite 57, 339–348. http://dx.doi.org/10.1016/j.appet.2011.05.325.Dopamine.

Brechan, I., Kvalem, I.L., 2015. Relationship between body dissatisfaction and disordered eating: mediating role of self-esteem and depression. Eat. Behav. 17, 49–58. http://dx.doi.org/10.1016/j.eatbeh.2014.12.008.

Bruch, H., 1961. The transformation of oral impulses in eating disorders: a conceptual approach. Psychiatr. Q. 35, 458–481.

Clum, G.A., Rice, J.C., Broussard, M., Johnson, C.C., Webber, L.S., 2014. Associations between depressive symptoms, self-efficacy, eating styles, exercise and body mass index in women. J. Behav. Med. 37, 577–586. http://dx.doi.org/10.1007/s10865-013-9526-5.

COTAN n.d. Beoordeling Nederlandse Vragenlijst voor Eetgedrag, NVE, 2013 [Review Dutch Eating Behaviour Questionnaire (DEBQ, 2013)]. Retrieved from http//www.cotandocumentatie.nl/test_details.php?id=848.

Eldregde, K., Agras, W., 1996. Weight and shape overconcern and emotional eating in binge eating disorder. Int. J. Eat. Disord. 19, 73–82.

Forman, E.M., Butryn, M.L., Hoffman, K.L., Herbert, J.D., 2009. An open trial of an acceptance-based behavioral intervention for weight loss. Cogn. Behav. Pract. 16, 223–235.

Fried, E.I., Nesse, R.M., 2015. Depression sum-scores don't add up: why analyzing specific depression symptoms is essential. BMC Med. 13, 72. http://dx.doi.org/10.1186/s12916-015-0325-4.

Goldbacher, E., La, C., Eugene, G., Stephanie, K., Veur, V., Foster, G.D., 2016. An initial evaluation of a weight loss intervention for individuals who engage in emotional eating. J. Behav. Med. 39, 139–150. http://dx.doi.org/10.1007/s10865-015-9678-6.

Goldschmidt, A.B., Crosby, R., Engel, S., Crow, S., Cao, L., Peterson, C., Durkin, N., 2014. Affect and eating behavior in obese adults with and without elevated depression symptoms. Int. J. Eat. Disord. 47, 281–286. http://dx.doi.org/10.1002/eat.22188.Affect.

Grilo, C.M., White, M.A., Masheb, R.M., 2009. DSM-IV psychiatric disorder comorbidity and its correlates in binge eating disorder. Int. J. Eat. Disord. 42, 228–234. http://dx.doi.org/10.1002/eat.20599.

Grimm, E.R., Steinle, N.I., 2011. Genetics of eating behavior: established and emerging concepts. Nutr. Bull. Londen 69, 52–60. http://dx.doi.org/10.1111/j.1753-4887.2010.00361.x.Genetics.

Gross, J., Thompson, R., 2007. Emotion regulation. Conceptual foundations. In: Gross, J. (Ed.), Handbook of Emotion Regulation. Guilford Press, New York, NY.

Haedt-Matt, A., Keel, P., Racine, S., Burt, A., Yueqin, J., Boker, S., Nearle, M., Klump, K., 2014. Do emotional eating urges regulate affect? Concurrent and prospective associations and implications for risk models of binge eating. Int. J. Eat. Disord. 47, 874–877. http://dx.doi.org/10.1038/jid.2014.371.

Heatherton, T.F., Baumeister, R.F., 1991. Binge eating as escape from self-awareness. Psychol. Bull. 110, 86–108. http://dx.doi.org/10.1037/0033-2909.110.1.86.

Heatherton, T.F., Kozlowski, L.T., Frecker, R.C., Fagerstrom, K., 1991. The Fagerstrom test for nicotine dependence: a revision of the Fagerstrom tolerance questionnaire. Br. J. Addict. 86, 1119–1127. http://dx.doi.org/10.1111/j.1360-0443.1991.tb01879.x.

Herman, C., Mack, D., 1975. Restrained and unrestrained eating. J. Pers. 43, 647–660. http://dx.doi.org/10.1111/j.1467-6494.1975.tb00727.x.

Jacka, F.N., Mykletun, A., Berk, M., Bjelland, I., Tell, G.S., 2011. The association between habitual diet quality and the common mental disorders in community-dwelling adults: the Hordaland Health study. Psychosom. Med. 73, 483–490. http://dx.doi.org/10.1097/PSY.0b013e318222831a.

Keskitalo, K., Tuorila, H., Spector, T.D., Cherkas, L.F., Knaapila, A., Kaprio, J., Silventoinen, K., Perola, M., 2008. The Three-Factor Eating Questionnaire, body mass index, and responses to sweet and salty fatty foods: a twin study of genetic and environmental associations. Am. J. Clin. Nutr. 88, 263–271.

Kessler, R.C., Berglund, P., Demler, O., Jin, R., Koretz, D., Merikangas, K.R., Rush, A.J., Walters, E.E., Wang, P.S., 2003. The epidemiology of major depressive disorder: results from the National Comorbidity Survey Replication (NCS-R). YAMA 289, 3095–3105.

Khan, A., Carrithers, J., Preskorn, S., Lear, R., Wisniewski, S., John Rush, A., Stegman, D., Kelley, C., Kreiner, K., Nierenberg, A., Fava, M., 2016. Clinical and demographic factors associated with DSM-IV melancholic depression. Ann. Clin. psychiatry 18, 91–98.

Konttinen, H., Männnistö, S., Sarlio-Lähteenkorva, S., Silventoinen, K., Haukkala, A., 2010a. Emotional eating, depressive symptoms and self-reported food consumption. A population-based study. Appetite 54, 473–479. http://dx.doi.org/10.1016/j.appet.2010.01.014.

Konttinen, H., Silventoinen, K., Sarlio-Lahteenkorva, S., Mannisto, S., Haukkala, A., 2010b. Emotional eating and physical activity self-efficacy as pathways in the association between depressive symptoms and adiposity indicators. Am. J. Clin. Nutr. 92, 1031–1039. http://dx.doi.org/10.3945/ajcn.2010.29732.

Lamers, F., Burstein, M., He, J.P., Avenevoli, S., Angst, J., Merikangas, K.R., 2012. Structure of major depressive disorder in adolescents and adults in the US general population. Br. J. Psychiatry 201, 143–150. http://dx.doi.org/10.1192/bjp.bp.111.098079.

Lamers, F., De Jonge, P., Nolen, W.A., Smit, J.H., Zitman, F.G., Beekman, A.T.F., Penninx, B.W.J.H., 2010. Identifying depressive subtypes in a large cohort study: results from The Netherlands Study of Depression and Anxiety (NESDA). J. Clin. Psychiatry 71, 1582–1589. http://dx.doi.org/10.4088/JCP.09m05398blu.

Lasserre, A.M., Glaus, J., Vandeleur, C.L., Marques-Vidal, P., Vaucher, J., Bastardot, F., Waeber, G., Vollenweider, P., Preisig, M., 2014. Depression with atypical features and increase in obesity, body mass index, waist circumference, and fat mass: a prospective, population-based study. JAMA Psychiatry 71, 880–888 doi:1878921 [pii]\\r10.1001/jamapsychiatry.2014.411 [doi].

Lazarevich, I., Irigoyen Camacho, M.E., Velázquez-Alva, M. del C., Zepeda Zepeda, M., 2016. Relationship among obesity, depression, and emotional eating in young adults. Appetite 107, 639–644. http://dx.doi.org/10.1016/j.appet.2016.09.011.

Levitan, R.D., Davis, C., Kaplan, A.S., Arenovich, T., Phillips, D.I.W., Ravindran, A.V., 2012. Obesity comorbidity in unipolar major depressive disorder: refining the core phenotype. J. Clin. Psychiatry 73, 1119–1124. http://dx.doi.org/10.4088/JCP.11m07394.

Luppino, F.S., de Wit, L.M., Bouvy, P.F., Stijnen, T., Cuijpers, P., Penninx, B.W.J.H., Zitman, F., 2010. Overweight, obesity, and depression. Arch. Gen. Psychiatry 67, 220–229.

Lyketsos, C.G., Nestadt, G., Cwi, J., Heithoff, K., et al., 1994. The Life Chart Interview: a standardized method to describe the course of psychopathology. Int. J. Methods Psychiatr. Res. 4 (3), 143–155.

Macht, M., 2008. How emotions affect eating: a five-way model. Appetite 50, 1–11. http://dx.doi.org/10.1016/j.appet.2007.07.002.

Milaneschi, Y., Lamers, F., Peyrot, W.J., Abdellaoui, A., Willemsen, G., Hottenga, J.-J., Jansen, R., Mbarek, H., Dehghan, A., Lu, C., Boomsma, D.I., Penninx, B.W.J.H., 2015. Polygenic dissection of major depression clinical heterogeneity. Mol. Psychiatry 21, 516–522. http://dx.doi.org/10.1038/mp.2015.86.

Milaneschi, Y., Sutin, A.R., Terracciano, A., Canepa, M., Gravenstein, K.S., Egan, J.M., Vogelzangs, N., Guralnik, J.M., Bandinelli, S., Penninx, B.W.J.H., Ferrucci, L., 2014. The association between leptin and depressive symptoms is modulated by abdominal adiposity. Psychoneuroendocrinology 42, 1–10. http://dx.doi.org/10.1016/j.psyneuen.2013.12.015.

Narum, S.R., 2006. Beyond Bonferroni: less conservative analyses for conservation genetics. Conserv. Genet. 7, 783–787. http://dx.doi.org/10.1007/s10592-005-9056-y.

Ouwens, M.A., van Strien, T., van Leeuwe, J.F.J., 2009. Possible pathways between depression, emotional and external eating. A structural equation model. Appetite 53, 245–258. http://dx.doi.org/10.1016/j.appet.2009.06.001.

Penninx, B.W.J.H., Beekman, A.T.F., Smit, J.H., Zitman, F.G., Nolen, W.A., Spinhoven, P., Cuijpers, P., de Jong, P., van Marwijk, H.W.J., Assendelft, W.J.J., van der Meer, K., 2008. The Netherlands Study of Depression and Anxiety (NESDA): rationale, objectives and methods. Int. J. Methods Psychiatr. Res. 17, 121–140. http://dx.doi.org/10.1002/mpr.

Penninx, B.W.J.H., Milaneschi, Y., Lamers, F., Vogelzangs, N., 2013. Understanding the somatic consequences of depression: biological mechanisms and the role of depression symptom profile. BMC Med. 11, 129. http://dx.doi.org/10.1186/1741-7015-11-129.

Pinaquy, S., Chabrol, H., Simon, C., Louvet, J., Barbe, P., 2003. Emotional eating, alexithymia, and binge- eating disorder in obese women. Obes. Res. 11, 195–201. http://dx.doi.org/10.1038/oby.2003.31.

Quirk, S.E., Williams, L.J., O'Neil, A., Pasco, J.A., Jacka, F.N., Housden, S., Berk, M., Brennan, S.L., 2013. The association between diet quality, dietary patterns and depression in adults: a systematic review. BMC Psychiatry 13, 175. http://dx.doi.org/10.1186/1471-244X-13-175.

Roosen, M.A., Safer, D., Adler, S., Cebolla, A., van Strien, T., 2012. Group dialectical behavior therapy adapted for obese emotional eaters; A pilot study. Nutr. Hosp. 27, 1141–1147. http://dx.doi.org/10.3305/nh.2012.27.4.5843.

Rush, J., Gullion, C., Basco, M., Jarrett, R., Trivedi, M., 1996. The inventory of depressive symptomatology (IDS): psychometric properties. Psychol. Med. 26, 447–486.

Saunders, J., Aasland, O., Babor, T., De la Fuente, J., Grant, M., 1993. Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption. Addiction 88, 791–804.

Schaakxs, R., Comijs, H.C., Lamers, F., Beekman, A.T.F., Penninx, B.W.J.H., 2016. Age-related variability in the presentation of symptoms of major depressive disorder. Psychol. Med. 1–10. http://dx.doi.org/10.1017/S0033291716002579.

Schachter, S., 1964. The interaction of cognitive and physiological determinants of emotional state. In: Berkowitz, L. (Ed.), Advances in Experimental Social Psychology. Academic, New York, NY.

Spoor, S.T.P., Bekker, M.H.J., Van Strien, T., Van Heck, G.L., 2007. Relations between negative affect, coping, and emotional eating. Appetite 48, 368–376. http://dx.doi.org/10.1016/j.appet.2006.10.005.

Steel, Z., Marnane, C., Iranpour, C., Chey, T., Jackson, J.W., Patel, V., Silove, D., 2014. The global prevalence of common mental disorders: a systematic review and meta-analysis 1980-2013. Int. J. Epidemiol. 43, 476–493. http://dx.doi.org/10.1093/ije/dyu038.

van Strien, T., 2015. Nederlandse Vragenlijst Voor Eetgedrag (NVE): Handleiding Dutch Eating Behavior Questionnaire: Manual.

van Strien, T., 1995. In Defense of psychosomatic Theory : a critical analysis of allison and heshka ' s critical analysis. Int. J. Eat. Disord. 17, 299–304.

van Strien, T., Frijters, J., Bergers, G., Defares, P., 1986. The Dutch Eating Behavior Questionnaire (DEBQ) for assessment of restrained, emotional, and external eating behavior. Int. J. Eat. Disord. 5, 295–315. http://dx.doi.org/10.1002/1098-108X(198602)5. 2 < 295::AID-EAT2260050209 > 3.0.CO;2-T.

van Strien, T., Konttinen, H., Homberg, J.R., Engels, R.C.M.E., Winkens, L.H.H., 2016a. Emotional eating as a mediator between depression and weight gain. Appetite 100, 216–224.

van Strien, T., van de Laar, F.A. van de, 2008. Intake of energy is best predicted by overeating tendency and consumption of fat is best predicted by dietary restraint: a 4-year follow-up of patients with newly diagnosed Type 2 diabetes. Appetite 50, 544–547. http://dx.doi.org/10.1016/j.appet.2007.08.005.

van Strien, T., Winkens, L., Toft, M.B., Pedersen, S., Brouwer, I., Visser, M., Lähteenmäki, L., 2016b. The mediation effect of emotional eating between depression and body mass index in the two European countries Denmark and Spain. Appetite 105, 500–508. http://dx.doi.org/10.1016/j.appet.2016.06.025.

van Strien, T., Zwaluw, C.S., Van Der Engels, R.C.M.E., 2010. Emotional eating in adolescents : a gene ( SLC6A4/5-HTT ) e Depressive feelings interaction analysis. J. Psychiatr. Res. 44, 1035–1042. http://dx.doi.org/10.1016/j.jpsychires.2010.03.012.

Verhoeven, J.E., Van Oppen, P., Révész, D., Wolkowitz, O.M., Penninx, B.W.J.H., 2016. Depressive and anxiety disorders showing robust, but non-dynamic, 6-year longitudinal association with short leukocyte telomere length. Am. J. Psychiatry 173, 617–624. http://dx.doi.org/10.1176/appi.ajp.2015.15070887.

Wardenaar, K.J., Van Veen, T., Giltay, E.J., den Hollander-Gijsman, M., Penninx, B.W.J.H., Zitman, F.G., 2010. The structure and dimensionality of the Inventory of Depressive Symptomatology Self Report (IDS-SR) in patients with depressive disorders and healthy controls. J. Affect. Disord. 125, 146–154. http://dx.doi.org/10.1016/j.jad.2009.12.020.

Werrij, M.Q., Mulkens, S., Hospers, H.J., Jansen, A., 2006. Overweight and obesity: the significance of a depressed mood. Patient Educ. Couns. 62, 126–131. http://dx.doi.org/10.1016/j.pec.2005.06.016.

Wiltink, J., Michal, M., Wild, P.S., Zwiener, I., Blettner, M., Münzel, T., Schulz, A., Kirschner, Y., Beutel, M.E., 2013. Associations between depression and different measures of obesity (BMI, WC, WHtR, WHR). BMC Psychiatry 13, 223. http://dx.doi.org/10.1186/1471-244X-13-223.

Wittchen, H., 1994. Reliability and validity studies of the who-composite international diagnostic interview (CIDI): a critical review. J. Psychiatr. Res. 28, 57–84.

World Health Organisation (WHO), 2014. WHO Collaboration Centre for Drug Statistics Methodology. World Health Organisation (WHO). [WWW Document]. Available at: www.whocc.no.

Zupancic, M.L., Mahajan, A., 2011. Leptin as a neuroactive agent. Psychosom. Med. 73, 407–414. http://dx.doi.org/10.1097/PSY.0b013e31821a196f.